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ABSTRACT

This study investigated the relationship between measured intelligence and discrepancies existing between actual achievement levels and projected achievement levels in mildly handicapped resource room students in Arkansas. Twenty-seven students had been identified as learning disabled and 19 as mildly mentally retarded. Subjects each received approximately 1 hour per day of remedial instruction in a resource room setting. Subjects were individually administered the Wechsler Intelligence Scale for Children--Revised and the Wide Range Achievement Test--Revised prior to placement in the resource room program and at the completion of approximately 3 years in the program. Major findings included: the mean intelligence quotient did not change significantly in the learning-disabled group though it changed in a positive direction for the mentally retarded group; discrepancies decreased between groups with remediation in reading and spelling; discrepancy in arithmetic between the two groups increased, with the mentally retarded group showing less discrepancy in arithmetic, the only area of significant improvement for either group; for the total group, reading achievement was the area most affected by remediation, but in a negative manner; and for the total group, variability in scores was greatest in arithmetic achievement. Appended are the formulae used in the regression model computer program. Includes five references. (DB)

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An Investigation of Discrepancy Scores Between Intelligence and WRAT-R Achievement in Mentally Retarded and Learning Disabled Students

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An Investigation of Discrepancy Scores Between Intelligence and WRAT-R Achievement in Mentally Retarded and Learning Disabled Students

Central to the issue of identification of handicapped children within the public school systems of the United States is the question of the impact of intelligence on achievement. While this is a subject that has received a great deal of attention, there remains little consensus as to the majority position. In his article, Lyon (1989) discussed the work of several notable authors in this area. While agreeing that present measures of intelligence fall short in assessing the global intelligence of a person, Lyon (1989) disagrees with the position that such measures do not sample intelligence. Many of the recent articles in this area address the complexities of a defining those catagories of handicap which relate directly to intelligence. For example, definitions for learning disabilities vary tremendously, and a consensus definition which will more accurately describe these students is lacking (Algozzine & Ysseldyke, 1987). According to authorities such as Reynolds (1985-85), it is safe to conclude that the tremendous disparities in measurement models are major factors in the differences in proportions of children identified as LD in the various states.

Public school programs for the exceptional child have long been concerned with the formulation of measurement criteria that would allow special needs students to be identified with acceptable levels of accuracy. Reynolds (1984-85) indicated that at least five major discrepancy formulas had been considered over the years in an attempt to quantify the "discrepancy" between ability and achievement. These formulas were

primarily dependent on the establishment of an expected grade equivalent (EGE), and included the following examples:

$$EGE = \text{no. of years in school} \times \frac{IQ}{100} + 1.0$$

$$EGE = \frac{IQ \times CA}{100} - 5.$$

$$EGE = (MA + CA + \text{Grade Age})/3 - 5.$$

$$EGE = (2MA + CA)/3 - 5.$$

$$\text{Severe Discrepancy} = \frac{IQ}{CA\ (300 + .17)} - 2.5$$

Similarly, Forness, et al (1983) listed eight formulas that were used in a study of learning disability discrepancy formulas. In addition to the above formulas, the article listed additional formulas of:

$$CA - 5$$

$$\frac{IQ}{CA\ (\text{Years in School} \times 100 + 1.0) - \text{Actual Reading Grade}}$$

$$\text{Learning Expectancy Level} = \text{Mental Age} - 5$$

$$\frac{\text{Actual Achievement Age}}{\frac{(\text{Mental Age} + \text{Chronological Age} + \text{Grade Age})}{3}}$$

Concerns about this state of affairs led the authors of this paper to investigate the relationship between measured intelligence and discrepancies existing between actual achievement levels and projected achievement levels in selected mildly handicapped resource room students in Arkansas public schools.

METHOD

Subjects

The subjects used in this study consisted of groups of students from two primary handicap areas, mild mental retardation and specific learning disabilities.

Twenty-seven (27) students who had undergone eligibility determination and labeling as learning disabled by a multi-disciplinary evaluation team served as subjects for that area of handicap. The criteria for being labeled as learning disabled followed the approved guidelines for the State of Arkansas, and basically consisted of: (a) average or above average intelligence; (b) weaknesses in specific learning processes; (c) a significant discrepancy between academic achievement and intellectual functioning; (d) normal visual and auditory acuity; and (e) not emotionally disturbed or significantly educationally disadvantaged. The WISC-R Full Scale IQ range for this group was 78 to 108.

Nineteen (19) students who had been labeled as mildly mentally retarded by a multi-disciplinary evaluation team served as subjects for the second handicap area in the study. Again, state guidelines for determination of

primary handicap in the area of mental retardation were used as diagnostic criteria including subaverage general intellectual functioning, and adaptive behavior deficits. The WISC-R Full Scale IQ range for this group of subjects was 52 to 75.

The subjects in both groups were randomly assigned to special education classes for the mildly handicapped in a rural school district. The district is located in central Arkansas, and has an average daily membership (ADM) of 2,473 students in grades K-12. Subjects were individually administered the Wechsler Intelligence Scale for Children - Revised (WISC-R) and the Wide Range Achievement Test - Revised (WRAT-R) prior to placement in the resource room program at the school. Subjects were each receiving approximately one hour per day of remedial instruction. An identical assessment was conducted at the completion of approximately three years in the special education classroom.

Treatment

It was found to be impossible to obtain an individual analysis of the specific treatment in the resource room for each subject in the study. Therefore, the perspective of the study was global in nature, and purported to measure only the effect of the time-in-class aspect of treatment. It was assumed that the individualized educational plan, as well as basic educational programming for each student was designed to remediate identified basic educational deficits. In addition, activities designed to maintain any identified strengths in the subjects were provided. It was further assumed that each subject was exposed to both individual and small group instruction in the resoruce setting.

Research Design

The variables measured in the study included the change in: (a) WISC-R Verbal, Performance, and Full-Scale Intelligence Quotient; (b) WRAT-R Reading, Arithmetic, and Spelling score; and (c) discrepancy scores obtained by a statistical treatment of data obtained from initial evaluation and re-evaluation of each student. Both groups used in the study, the mentally retarded and the learning disabled, were subjected to analysis aimed at determining treatment efficacy within stated conditions. A paired-observation t-test was used to process initial and re-evaluation WISC-R and WRAT-R data. In addition, an independent samples t-test was employed to assess changes in discrepancy scores between groups. A computer-generated regression formula (Appendix A) was used to make predictions of achievement in reading, spelling, and arithmetic on the WRAT-R.

Results

Table 1 presents the test-retest WISC-R means, standard deviations, and probabilities for the subjects of the study. The t-test analysis revealed that the mentally retarded group Full Scale IQ (FSIQ) significantly increased at p .05, while the learning disabilities group had no significant change in FSIQ over the three year period. The change that did occur among the learning disabilities group, while not significant, was notable because the change was in the opposite direction of the change in the mentally retarded group.

Table 1

Group Test-Retest FSIQ Means, Standard Deviations, and Probabilities

	Initial		Reevaluation		
Group FSIQ	M	SD	M	SD	p
MR	65.632	7.719	69.526	8.389	.046*
LD	89.538	8.387	88.923	9.826	.646

*p .05

Table 2 is a presentation of group achievement results from the WRAT-R. This table will reflect changes in achievement test scores from initial to re-evaluation.

Table 2

Changes in WRAT-R Reading, Spelling, and Arithmetic Standard Scores

	Reading			Spelling			Arithmetic		
Group	1	2	Change	1	2	Change	1	2	Change
MR	64.63	60.84	-3.79	65.42	64.21	-1.21	64.00	71.47	+7.47
LD	70.63	67.07	-3.56	71.82	69.59	-2.23	79.63	77.74	-1.89

It is evident from the data obtained that regression in achievement test scores occurred among both groups, with the exception of arithmetic scores for the mentally retarded group. Changes in standard scores for the learning disabled group ranged from -1.89 points in arithmetic to -3.56 in reading achievement. Among the mentally retarded subjects, changes ranged from -1.21 in spelling to +7.47 in arithmetic.

Table 3 presents discrepancy scores obtained for the total group. These scores represent the difference between actual standard score achievement on the WRAT-R and predicted standard score achievement in reading, spelling, and arithmetic. Predicted achievement was obtained by subjecting the data to a computer-assisted regression formula (Appendix A). Standard scores were utilized to compensate for differences among the subjects in chronological age, IQ, and number of years in school.

Table 3

Computed Discrepancy Scores on WRAT-R Reading, Spelling, & Arithmetic

	Reading			Spelling			Arithmetic		
Group	R1	PR1	D	S1	PS1	D	A1	PA1	D
MR	64.63	76.96	-15.03	65.42	80.23	-14.81	64.00	76.96	-12.96
LD	70.63	93.82	-23.20	71.82	93.97	-22.15	79.63	93.02	-13.39
Group	R2	PR2	D	S2	PS2	D	A2	PA2	D
MR	60.84	81.77	-20.93	64.21	81.86	-17.65	71.47	79.23	- 7.76
LD	67.07	93.10	-26.03	69.59	92.77	-23.18	77.74	92.43	-14.69

Group discrepancy scores, in all instances, were of negative value. That is, neither the mentally retarded group nor the learning disabled group achieved at the predicted level in any of the areas tested. The smallest discrepancy occurred in arithmetic achievement for the mentally retarded group on re-evaluation. In fact, this was the only area of actual gain in achievement for either group in any WRAT-R area.

Table 4 is a representation of probabilities of discrepancy scores on the WRAT-R between the mentally retarded group and the learning disabled group. There was found to be significant differences in reading achievement between groups on initial evaluation, but not on re-evaluation. Significant differences between groups were obtained in the area of spelling on both initial evaluation and re-evaluation. In the area of arithmetic, differences were found to be not significant on initial evaluation, but significant on re-evaluation.

Table 4

Significance of Discrepancy Scores Between Groups on the WRAT-R

Group	N	WRAT-R Area	Mean Discrepancy	p
MR	19	Reading 1	-15.026	
LD	27	Reading 1	-23.193	
				.002*
MR	19	Reading 2	-20.932 (+5.9)	
LD	27	Reading 2	-26.030 (+2.8)	
				.088
MR	19	Spelling 1	-14.805	
LD	27	Spelling 1	-22.156	
				.004*
MR	19	Spelling 2	-17.653	
LD	27	Spelling 2	-23.178	
				.037*
MR	19	Arithmetic 1	-12.963	
LD	27	Arithmetic 1	-13.389	
				.911
MR	19	Arithmetic 2	- 7.758 (-5.2)	
LD	27	Arithmetic 2	-14.689 (+1.7)	
				.023*

*p .05

Table 5 represents the actual achieved Standard Scores versus the predicted achieved Standard Scores on the WRAT-R by group. As previously stated, the predicted achievement level was computed using a regression model.

Table 5

Actual Versus Predicted WRAT-R Achievement Scores by Group

Mentally Retarded (N = 19)

Reading 1 Mean Standard Score:	64.632
Predicted Reading 1 Mean Standard Score:	79.658
Reading 2 Mean Standard Score:	60.842
Predicted Reading 2 Mean Standard Score:	81.774
Spelling 1 Mean Standard Score:	65.421
Predicted Spelling 1 Mean Standard Score:	80.226
Spelling 2 Mean Standard Score:	64.211
Predicted Spelling 2 Mean Standard Score:	81.863
Arithmetic 1 Mean Standard Score:	64.000
Predicted Arithmetic 1 Mean Standard Score:	76.963
Arithmetic 2 Mean Standard Score:	71.474
Predicted Arithmetic 2 Mean Standard Score:	79.232

Learning Disabled (N = 27)

Reading 1 Mean Standard Score:	70.630
Predicted Reading 1 Mean Standard Score:	93.822
Reading 2 Mean Standard Score:	67,074
Predicted Reading 2 Mean Standard Score:	93.104
Spelling 1 Mean Standard Score:	71.815
Predicted Spelling 1 Mean Standard Score:	93.370
Spelling 2 Mean Standard Score:	69.593
Predicted Spelling 2 Mean Standard Score:	92.770
Arithmetic 1 Mean Standard Score:	79.630
Predicted Arithmetic 1 Mean Standard Score:	93.019
Arithmetic 2 Mean Standard Score:	77.741
Predicted Arithmetic 2 Mean Standard Score:	92.770

The data presented in Table 6 is a Pearson Correlation Matrix computed for initial/re-evaluation achievement scores on the WRAT-R for the entire study group. All correlations were found to be positive. And, as one might imagine, initial evaluation scores serve as fairly good predictors of re-evaluation achievement with one major exception. Arithmetic initial evaluation scores predicted re-evaluation scores very poorly for the entire study group. This can best be explained by the significant gains made in arithmetic achievement over the three year period by the mentally retarded group. One would expect that initial achievement would only predict re-evaluation achievement where there had been little change in achievement. Interestingly enough, initial reading score predicted spelling re-evaluation achievement slightly better than reading re-evaluation achievement.

Table 6

Pearson Correlation Matrix for WRAT-R Achievement Scores

	R1	R2	S1	S2	A1	A2
R1	1.000					
R2	0.501	1.000				
S1	0.639	0.541	1.000			
S2	0.550	0.762	0.614	1.000		
A1	0.380	0.220	0.513	0.281	1.000	
A2	0.473	0.367	0.310	0.482	0.184	1.000

Results and Discussion

In an attempt to present the findings of this study in as clear a manner as possible, the authors have chosen the format of summary statements. Although many of these statements are inconclusive, it is assumed that they will give rise to further thought and/or investigation.

1. The mean intelligence quotient as measured by the WISC-R did not change significantly in the learning disabled group over the three year period. It was not surprising to find that the FSIQ for this group decreased slightly over the three year period. Similar results had been previously reported by Cronin & Kazmierski,(1989).

2. The mean intelligence quotient as measured by the WISC-R did make a significantly positive change in the mentally retarded group.

3. The learning disabled group showed more discrepancy between predicted achievement versus actual achievement. This finding was to be expected due to the diagnostic criteria of identification.

4. Discrepancies decreased between groups with remediation in reading and spelling. That is, the two study groups became more alike in relation of discrepancies between predicted and actual achievement.

5. The mentally retarded group's discrepancy in reading achievement increased at a higher rate than did the learning disabled group. That is, the MR group fell behind in achievement at a faster rate than the LD group.

6. Discrepancy in arithmetic increased. That is, the two groups became less alike as far as discrepancy in arithmetic achievement. The MR group's discrepancy in arithmetic decreased or improved, whereas the LD group's discrepancy in arithmetic increased. There was no significant difference between groups in arithmetic achievement on initial evaluation, but a significant difference did occur on re-evaluation in arithmetic.

7. The only area of significant improvement for either group was in arithmetic achievement for the mentally retarded group. All other achievement areas made either no significant gain, or decreased at a significant level.

8. The positive change in arithmetic achievement for the MR group may indicate that arithmetic achievement is more closely tied to IQ than is reading or spelling.

9. As IQ increased in the MR group, predicted reading, spelling, and arithmetic scores also increased. Findings of the study, however, were that reading and spelling achievement decreased. This finding would help to explain the increase in discrepancy among this group.

10. Among the LD subjects, since IQ remained stable from initial to re-evaluation, the predicted achievement scores were less affected than among the MR subjects.

11. For the MR study group, achievement in reading increased with remediation at a significant level.

12. For the MR study group, achievement in spelling increased with remediation, but not at a significant level.

13. For the MR study group, discrepancy in achievement in arithmetic decreased with remediation, but not significantly. Although the improvement was 5.205 points, the significance was affected by the large variability in scores within this group (SD = 16.966).

14. For the LD study group, discrepancy in achievement in reading, spelling, and arithmetic increased with remediation, but not at significant levels.

15. For the total group, reading achievement was the area most affected by remediation, but in a negative manner.

16. For the total group, variability of scores was greatest in arithmetic achievement.

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Appendix A

FORMULAE USED IN THE REGRESSION MODEL COMPUTER PROGRAM

1. Test of the significance of the difference of two obtained scores:

$$z = \frac{x_1 - y_1}{\sqrt{2 - r_{xx} - r_{yy}}}$$

where:

		program line numbers:
x_1	= obtained IQ standard score	400-440
y_1	= obtained achmt. standard score	
r_{xx}	= IQ test internal consist. reliability	
r_{yy}	= achmt. test internal consist. reliability	

$z \geq 1.65$ means that we can be 95% certain that a real difference (one not likely due to chance) exists between the two obtained scores.

2. Determining the mean achievement score for students of an IQ:

$$Y = (x_1 - \bar{x})r_{xy} + \bar{x}$$

where:

		program line numbers:
Y	= the achievement score of most students with an IQ of X	150, 510, 520
x_1	= obtained IQ score	
$\bar{x}$	= mean IQ score	
r_{xy}	= correlation between IQ and achmt. tests	

3. Determining the discrepancy:

$$\text{Discrepancy} = \hat{Y} = y_1$$

where:

		program line numbers:
$\hat{Y}$	= the achievement score of most students of the same IQ	530
y_1	= the student's achmt. standard score	

4. Standard deviation of the discrepancy ($SD_{y=y_1}$):

$$SD_{y-y_1=0} \sqrt{1-r^2_{xy}}$$

where:

		program line numbers:
0	= standard deviation of IQ and achmt. tests	540-550
r_{xy}	= correlation between IQ and achmt. tests	

6. Standard error of the discrepancy (SE_{Y-Y_1}):

$$SE_{Y-Y_1} = \sqrt{1 - r^2_{xy}}\ \sqrt{1 - r_Y - Y_1}$$

where: r_{xy} = correlation between the IQ and achmt. tests (program line numbers: 610-630)

r_{Y-Y_1} = reliability of the discrepancy

7. Conditions for a "severe" discrepancy:

$Y - Y_1$ is severe if $Y - Y_2 \geq 2\sigma \sqrt{1 - r^2_{xy}} - 1.65 SE_{Y-Y_1}$

where: $Y - Y_1$ = the discrepancy (program line numbers: 640-660)

σ = std. deviation of the achmt. test

r_{xy} = correlation between the IQ and achmt. tests

SE_{Y-Y_1} = standard error of the discrepancy

8. Overall formula:

A severe discrepancy exists if:

$$[(X_1 - \bar{x})\, r_{xy} + \bar{x}] - Y_1 \geq 2\sigma\sqrt{1-r^2_{xy}} - 1.65\sigma\sqrt{1 - r^2_{xy}}\ \sqrt{\frac{1 - r_{yy} \cdot r_{xx} \cdot r_{yy} - 2r^2_{xy})}{1 - r^2_{xy}}}$$

achmt. of most students with the student's IQ score — student's achmt. score — $\geq$ — two standard deviation discrepancy — standard error of measurement at 95% confidence level

Source: Evan, L., & Hilden, A. (1986). Regression analysis program. Montana Office of Public Instruction, Helena, Montana